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*One hundred and forty scientists, technologists and theologians gathered in Bucharest, Romania, 24 June - 2 July 1974 for a WCC Conference on Science and Technology for Human Development. What follows are extracts from the report of this Conference with specific reference to the energy crisis, together with information on a proposed ecumenical hearing on the risks and potentialities of expansion of nuclear power programmes.**

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Search for a Just and Sustainable Society

Improving the quality of life

The purpose of thinking about humanity's future in long-range terms is to achieve a higher quality of life than can be attained through a succession of short-term policies. Consideration of the swelling material activity on our fragile, finite planet leads to the conclusion that a point is reached when the benefits of more material production and the material demands of an increasing number of people no longer outweigh the negative effects of this growth on the non-material dimensions of the quality of life. Since many of the negative effects appear only after a lengthy delay, judgment as to the point at which further growth reduces the quality of life depends on the planning horizon employed. Feeling a responsibility at least for our grandchildren, and sensing an incapacity of the physical environment to support for long a load significantly higher than today's, we believe that the rich segments of the world have now reached the critical point where material expansion will reduce the quality of life for some people at some time within the period of concern to us. The remaining, poorer, members of humanity are at a stage where the current benefits of material expansion, except in terms of population, are far larger than the probable costs in terms of reduced quality of life now or in the relevant future. Thus today the quality of life, in the perspective of our planning horizon, will be increased by material growth among the poor and by stabilization and possibly contraction among the rich.

The sustainable society

Once the material conditions of today's poor have been improved, the crucial objective will become the avoidance of forced regression (for example, through the collapse of a highly stressed agricultural system) to a less desirable state.

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* The full report of the conference and additional information on plans for the hearing may be obtained from Church and Society, World Council of Churches, Geneva.

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The goal [illegible] robust, sustainable society, where each individual can fee secure that [illegible] of life will be maintained or improved. We can already delineate some necessary characteristics of this enduring society. First, social stability cannot be obtained without an equitable distribution of what is in scarce supply or without common opportunity to participate in social decisions. Second, a robust global society will not be sustainable unless the need for food is at any time well below the global capacity to supply it, and unless the emissions of pollutants are well below the capacity of the ecosystem to absorb them. Third, the new social organization will be sustainable only as long as the rate of use of non-renewable resources does not outrun the increase in resources made available through technological innovation. Finally, a sustainable society requires a level of human activity which is not adversely influenced by the never-ending, large and frequent natural variation in global climate.

In essence, the sustainable society will be one with a stable population and with a fixed material wealth per person, a society actively pursuing quality of life in basically non-material dimensions such as leisure, service, arts, education and sport. In the sustainable state, problems will appear at a more manageable rate than today. People will be able to afford the luxury of delaying the use of new technology to increase human options (for example, through an expansion of the global productivity or improved capacity to live a better life within existing limits) only after the unavoidable side effects are unearthed and publicized and after decision to implement is agreed upon in spite of the unintentional effects of the new technology. More concretely, we foresee a world where (1) the security of the individual, (2) the redistribution of material wealth, and (3) the implementation of a maximum consumption level are all effected by a transnational social security system dividing the responsibility for the fate of the individual among all people. In order to preserve valuable cultural diversity, responsibility for various social activities will be internationalized, regionalized, or nationalized only to the extent necessary for sustainability.

The urgently needed transition

The tremendous changes in attitudes towards the national welfare state experienced during the last generation, make us hopeful that a similar acceptance of a sustainable global welfare society can be effected over the next generation, particularly since the need is so much stronger. There is little time for hesitation. The human impact on our finite planet is growing every day and will continue to do so for decades even after a decision is taken to limit this impact, due to the sluggish momentum in our social institutions, our population numbers, and the accumulated impact on our bodies of years of consumption of chemical compounds with obscure effects. There is a growing understanding of the need to plan in terms, not of today's population, but of the population we will unavoidably have thirty years from now. Similarly, it is necessary to estimate, not the current levels of pollution and political coercion but the possible future levels. To avoid catastrophe in an expanding system, efforts to control the growing impact must be begun before the *anticipated* levels approach the unacceptable. Normally this implies action at a time when the present situation is still acceptable, often even desirable. Doubts already exist in many quarters about the globe's capacity to sustain the anticipated population of the earth, and this doubt will become a certainty if there is delay of a wholehearted initiation of the transition into a sustainable society, beginning with reducing consumption and limiting material waste among the rich, and by defusing the social explosiveness caused by inequity and poverty. Even at the risk of being unable to complete the transition

to a sustainable society, we must have the faith to take the first step, and to believe that human ingenuity can overcome the obstacles generated by the further material expansion which will inevitably occur during the interim period.

Energy : long-term prospects

The significance of energy availability is obscured in the Gross National Product approach to the assessment of economic growth. Professor K. E. Boulding has written about the role of the discovery of new sources of materials and energy as follows : "Modern society, which grew out of this great expertise in knowledge, depends for its high productivity not only on the knowledge itself but also on the great increase in energy inputs which that knowledge permitted. It is not surprising that there is a very high correlation between the per capita energy input of society and its per capita gross product. Our present technology, therefore, cannot be sustained for very long, simply because the energy resources which sustain it are exhaustible."

Few people will argue against this definition of the link between energy and the rise of modern society. The problem of sustaining an increasing world population is to a large extent identical with that of assuring a steady increase in the availability of energy at the lowest possible price. The fourfold increase of oil prices already has had serious adverse effects in industrialized countries, but this rise is a far greater strain for developing countries. This is because the former have the freedom to adjust their investment pattern and (to a certain extent) to control the level of individual consumption, whereas in the latter, with their subsistence economies, *another lifeline to food and agricultural production is thereby threatened.* To put it in the words of the Washington Oil Conference of February 1974 : "It was acknowledged that even the best cooperative efforts between nations will offset only a fraction of the serious damage which has been done to many countries by the abrupt and spectacular increase in oil costs. Action to resolve the plight of the developing countries where bigger oil import bills threaten to wipe out most of the development aid must clearly be given an immediate high priority."

It is doubtful that this has been done. Furthermore, while estimates of the future availability of oil at the present rate of production remain uncertain, it is accepted that oil is a readily exhaustible energy source. It will only help to bridge the gap to more sensible and hopefully to more accessible energy sources. Our problem is to make it and other forms of fuel last until such sources are available.

Only the availability of new sources will lead on to a sustainable state of energy production. In the immediate and medium term, these should conform to the following criteria :

a) the energy should be easily accessible so as not to constitute an intrinsic or natural monopoly ;

b) it should be capable of sustaining the supply of energy for a wide range of unit sizes, i.e. from a large urban network down to the single generator for village-scale production ;

c) the energy produced must be easy to distribute, e.g. electricity, although its distribution is more expensive than that of most other means.

The nuclear power station

It remains an open question whether the widespread proliferation of nuclear power plants is a desirable choice for society to make. Yet throughout the Western world, there are already clear signs of a growing dependence on this form of

energy production. Since national energy policies are prepared in isolation, it is doubtful that the collective international impact of these rapidly expanding construction programmes has been systematically assessed. Indeed, during the Stockholm Conference, the Director-General of the International Atomic Energy Agency indicated that he expected that by the year 2000 commissioning of a 1000 MW (e) nuclear power plant somewhere in the world would be an almost daily event. In some countries, nuclear power already provides 10 per cent of the electricity requirement.

But questions are being raised about the availability of reasonably priced uranium. By about 1985, cumulative requirements could exceed resources recoverable at $20 per kg and, should annual requirements rise from 50,000 to 100,000 tons after 1985, it will be necessary to discover and develop an additional one million tons of uranium to build up an eight to ten years' forward reserve. The problem of depletion of uranium resources could be eliminated by turning from thermal reactors to breeder reactors for power generation.

However, the technology of breeder reactors is by no means proved. There are still formidable difficulties to be overcome, including not only the unsolved waste disposal problem but also the production of an accident-proof design. Even if this new technology can survive the rigorous assessment that will be essential prior to the widespread introduction of commercial breeder-based electrical power generation, there is no prospect of these reactors taking over a significant fraction of the energy burden before the mid-1990s.

The prospect of the use of fusion power is even further distant, and the deuterium-tritium fusion process, which is probably the easiest, raises problems in the very long term regarding supplies of tritium that is produced from lithium. On the other hand, the deuterium-deuterium reaction, if it could be harnessed, would give almost unlimited energy although not necessarily cheaply.

A realistic appraisal of the implications of the nuclear process would seem to indicate unprecedented demands on capital, mineral resources and industrial capabilities, increasingly centralized systems of production, and a potentially large-scale environmental impact. The nuclear option entails risks whose magnitude is a matter of debate. Widely divergent views of these risks are held in the scientific community. Many people find them unacceptable especially when there seems to be a chance that oil and coal may be so managed as to fill the gap that exists until alternative technology produces a non-polluting and safe source of energy.

A brief table of arguments for and against is given below:

Nuclear power option

For:	*Against:*
A source of energy, particularly when other sources are scarce	Radioactive wastes constitute a hazard for present and future generations
Saves fossil fuels for other purposes in chemical industries	Possibility of accidents that could spread radioactive materials
Causes less air pollution	Vulnerability to sabotage
	Centralization of power source
	Increases the technological gap between poor and rich countries
	Possibility of increasing availability of material for nuclear weapons

Alternative energy technology

Following this brief appraisal of the nuclear power option — which in any case can be taken up by only very few countries in the developing world — there is certain to be an increasing demand for more flexible and more diverse systems of energy supply. If the long-term problem of production is to be solved, these will have to be based on "income" sources of energy, notably wind, wave and solar inputs, rather than on the more traditional "capital" sources of fossil fuels. For the most part, these technologies will conform to the criteria of small-scale, greater accessibility and low environmental impact.

Solar energy collectors do not benefit by scale increase ; small domestic heating units are already in use and solar distillation units are economic in sunny areas with high fuel costs. Solar collection linked to power production through photo voltaic cells is much less promising than direct heating applications with a current conversion of solar to electric power of less than 5 per cent, although improved but very expensive cells might give conversion efficiencies as high as 10 per cent.

There are real possibilities of supplementing electricity supplies by the use of equilibrium sources, namely, geothermal, tidal and wind power. Of course, these sources all rely for their effectiveness on particular geographical conditions, but they have not been properly evaluated and are consequently under-utilized.

Geothermal energy associated with volcanic activity is stored in the earth at depths of up to 1-3 km. While this form of geothermal energy has been technically available for the past 70 years in many locations, the total quantity is small and consequently only of local interest. This must still be considered as the consumption of capital in the form of hot water and dry steam rather than as energy income. To gain access to the energy of the earth's interior it will be necessary to drill two holes down to 5-10 km, and then to circulate water through these holes. In addition, it will be necessary to fracture the rocks at this depth in order to obtain good thermal contact over a large surface area. According to recent theoretical studies, the utilization of geothermal energy from hot dry rock could prove to be technologically feasible. Drilling technology at depths of 6-8 km is almost routine and the cracking of deep rocks is an established part of oil field practice. The ultimate potential of this energy source remains uncertain although it could have a profound effect on world energy supplies.

Relatively minor sources of free energy, such as windmills for local power production, have been in use for centuries and must continue to be developed despite the minimal impact on the aggregate energy demand.

Electricity generation based on fossil fuel combustion or nuclear power systems will continue to be a primary feature of most economies. While advances in the efficiency of design and construction have been made over several decades, a plateau of development has been reached where conversion efficiencies are unlikely to exceed 40 per cent with present materials and techniques. "Wasted" heat represents 60 per cent of the input energy and is usually squandered, with subsequent thermal water and air pollution problems. Major technical developments aimed at using this waste heat for district heating, desalination, agriculture, fish farming, and so on, need to be implemented. In particular, an increased flexibility of approach by electric utilities is urgently needed ; this is an international problem but is frequently not appreciated as such.

Recommendation :

The WCC is urged to initiate a study of the major moral, economic, social and scientific implications of the extension of atomic energy plants in the world.

Proposal for an ecumenical hearing

The Central Committee of the World Council of Churches, meeting in Berlin, 11-18 August, requested the officers and staff of Church and Society to make a preliminary assessment of "the risks and potentialities of the expansion of nuclear power". The action of the Central Committee was in response to a recommendation of the WCC Conference on Science and Technology for Human Development.

In accordance with this request, the Sub-Unit on Church and Society has begun consultations with nuclear scientists, political leaders and social planners seeking advice on the issues to be considered. During a visit to Vienna, 23-26 October 1974, Dr John Francis, a nuclear physicist and Senior Research Fellow for Energy Studies of Harriot-Watt University, Edinburgh, and Dr Paul Abrecht, Director of Church and Society, met with scientists and others on the staff of the International Atomic Energy Agency (United Nations), with Prof. Wolf Häfele, Deputy Director of the International Institute for Applied Systems Analysis, and coordinator of the Institute's Energy Project, and with Mr Abderrahmen Khene, the Secretary General of the Organization of Oil Exporting Countries (OPEC), to secure their counsel on a range of questions pertinent to such an investigation by the churches.

The following proposals have been developed on the basis of these preliminary conversations.

The urgency of the issue

A number of factors have converged to increase the urgency of broader public examination of the consequences of the expansion of nuclear power. The oil embargo of 1973, the energy crisis linked with the rapid rise in the price of oil, and the possible exhaustion of fossil fuels have obliged nations to press the search for alternative sources of energy, leading many governments to move towards a more rapid development of nuclear power programmes than envisaged earlier.

Present estimates by the IAEA and other bodies speak of accelerated increases of nuclear power production by 1985, and beyond that by the turn of the century. This would mean a large increase in the number of nuclear energy plants by 1985, a prospect which has aroused the concern of many scientists and laymen alike.

As Dr Sigvard Eklund, Director General of the IAEA noted in his statement to the 18th Regular Session of the General Conference of the Agency (16 October 1974): "In some countries there is, to put it mildly, a deep reluctance to accept nuclear power as a way out of the present difficulties."

The concern of the churches

It is obvious from what has been learned during these preliminary contacts and conversations that a proper evaluation of the factors which will influence public acceptability of expanded nuclear power cannot be easily or quickly accomplished. Moreover a number of organizations, including the IAEA and other UN agencies, are already deploying considerable efforts to assess the risk and provide the proper safeguards. However, we are left with the impression that the ethical values and social guidelines implicit in the present discussions need to be clarified

and that the churches might have a constructive contribution to make at this point. Church members, like almost everyone else, are only beginning to understand the enormous implications of the future of nuclear power development on a worldwide basis. An assessment by the World Council of Churches could help to encourage substantial discussion in the churches prior to and after the Nairobi Assembly and might also contribute to the discussion of the nuclear policy for the future which, at the international level, will be the concern of the next UN World Conference on the Peaceful Uses of Atomic Energy in 1977.

Accordingly, the Sub-Unit on Church and Society proposes to hold a hearing on the risks and potentialities of the further expansion of nuclear power programmes. The hearing group will consist of theologians, nuclear scientists and political leaders.

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